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Follow-On Friction Testing of Retro-Reflective Glass Beads

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16. Abstract

In 1993 and 1994 the FAA Technical Center conducted an evaluation of retro-reflective beads in airport pavement markings. That study proved that the addition of glass beads greatly enhanced the conspicuity of the surface markings. In the study the beaded stripes had a silica (sand) friction enhancement added to the paint. A concern arose as to the friction characteristics of beaded paint without silica.

The current study was conducted to test the friction levels of painted surface markings with and without beads and/or silica. Results of this study indicate that the friction levels of surface painted markings can be increased by adding retro-reflective glass beads to the paint. Silica also increased the friction of the surface markings; however, when glass beads were also added, the benefit of silica was reduced due to its smaller size in relation to the size of the beads.

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EXECUTIVE SUMMARY

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A test bed of 18 runway centerline stripes consisting of six different scenarios of three stripes each was designed and installed at Atlantic City International Airport's runway 04. The different scenarios covered possible combinations of beads and silica available.

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INTRODUCTION

BACKGROUND.

Following the 1993-94 study entitled "Evaluation of Retro-Reflective Beads in Airport Pavement Markings" (DOT/FAA/CT-94/120, December 1994) concern arose as to the friction characteristics of the beaded paint without a silica friction enhancement. This follow-on testing of friction levels of airport pavement markings was conducted as a result.

A test bed of 18 runway centerline stripes consisting of six different scenarios of three stripes each was designed. The different scenarios covered possible combinations of beads and silica available.

Upon completion of the installation of the test stripes, friction readings were recorded using the K.J. Law Runway Friction Tester owned and operated by the Federal Aviation Administration (FAA) William J. Hughes Technical Center. Multiple friction testing runs were conducted on two different test dates. The first test date was prior to the first snowplow operations conducted at Atlantic City International Airport. The second testing date was after snowplow operations to determine any changes in the surface texture of the stripes due to the impact of the snowplow blades on the beads.

The data collected from this evaluation will assist in the completion of the changes to AC 150/5370-10A, "Standards for Specifying Construction of Airports," that are being made as a result of the referenced previous testing of airport pavement marking materials.

PURPOSE.

The testing was conducted in response to a request from the Office of Airport Safety and Standards (AAS-200) to further investigate the effects that retro-reflective glass beads and/or silica may have on runway friction values when added to airport surface painted markings.

OBJECTIVE.

The objective of the testing was to determine the effect on runway friction when retro-reflective glass beads and/or silica are added to airport surface painted markings. This objective was achieved by conducting friction tests over painted surfaces that had no additives, had either of two types of glass bead additives, had a silica additive, and had both glass bead and silica additives.

TEST PROCEDURES.

A test bed of 18 runway centerline stripes consisting of three stripes each of the six different scenarios was designed as follows:

1. Waterborne paint only
2. Waterborne paint with 1.5 IOR beads
3. Waterborne paint with 1.9 IOR beads
4. Waterborne paint with silica
5. Waterborne paint with silica and 1.5 IOR beads
6. Waterborne paint with silica and 1.9 IOR beads

The paint was installed by a contractor on runway 04 at Atlantic City International Airport. The paint was a water-based product meeting the requirements of federal specification TT-P-1952D and was applied at the standard wet film thickness of 15 mils. The retro-reflective glass beads met the requirements of federal specification TT-B-1325C, Types I and III. The Type I beads (1.5 IOR) were applied at a rate of seven pounds per gallon and the Type III beads (1.9 IOR) were applied at a rate of 10 pounds per gallon. The silica was white foundry grade composed of at least 99.5 percent silicon dioxide when tested in accordance with ASTM C146. The gradation of the silica fell within the 50-70 AFS grades. The silica was applied at a rate of nine pounds per gallon. All additives were applied through a gravity fed hopper using a walk behind airless paint sprayer. The paint sprayer applied the paint in 6-inch stripes requiring six passes to complete one fully painted stripe.

When both beads and silica were applied to the paint stripe, the materials were premixed in a clean bucket in the proper proportions and then added to the hopper. A test was conducted prior to using this procedure to determine whether the beads and silica would separate when vibrated, thus changing the consistency of the bead to silica ratio. The test proved that the ratio remained consistent and the installation proceeded using the premix process.

Upon completion of the installation of the test stripes, friction readings were recorded using the K.J. Law Runway Friction Tester owned and operated by the FAA William J. Hughes Technical Center. The tests were conducted with the water application system applying the typical one millimeter film of water in front of the friction measuring tire.

The original plan called for the friction testing to be conducted on a bi-weekly basis for approximately 3-4 months or until the first snowplow operations were conducted at the airport. The reason being that the snowplows can damage the glass beads and therefore change the surface texture of the stripes. This became evident in the previous glass beads study. In that study the bead retention was very good on all but a few of the test stripes until the snowplows were used on the runways and taxiways. The use of the snowplow caused a change in the stripe texture that would then make comparisons between friction tests of the different seasons inaccurate when trying to determine the natural wearing of the materials.

RESULTS

The first test consisted of three test runs over the test stripes with the water application on. The data from the three stripes of each material combination were averaged over the three test runs and complied in table 1.

The original plan called for friction testing to be conducted on a bi-weekly basis for approximately 3-4 months. However, following the first set of data runs with the friction tester, two snowstorms hit the region requiring the airport to use snowplows on runway 04. Once the runway was completely clear of any snow or ice a visual inspection was made, and the second set of friction data runs consisting of four test runs with the water application on were recorded to determine the effects the snowplow damage to the glass beads had on the friction value of the test stripes. The averages for the second set of friction data are found in table 2.

A visual inspection of the glass beads was conducted to record the extent of the damage to the beads caused by the plow blades. The visual inspection determined that the bead retention of the 1.5 IOR beads was better than that of the 1.9 IOR beads. In either case there was still a sufficient number of beads in place to provide enough reflectance to enhance the pavement markings. However, it was determined that the loss of the beads from the paint stripes was the cause of the decline in the friction values during the second round of testing.

TABLE 1. AVERAGE FRICTION VALUES — 12/4/95

	AVERAGE FRICTION (mu)		
MATERIAL	Paint	Pavement	Change
Waterborne paint only	0.54	0.86	-0.32
Waterborne paint with 1.5 IOR beads	0.64	0.85	-0.21
Waterborne paint with 1.9 IOR beads	0.63	0.84	-0.21
Waterborne paint with silica	0.84	0.80	+0.4
Waterborne paint with silica and 1.5 IOR beads	0.66	0.80	-0.14
Waterborne paint with silica and 1.9 IOR beads	0.67	0.82	-0.15

TABLE 2. AVERAGE FRICTION VALUES — 1/30/96

	AVERAGE FRICTION (mu)		
MATERIAL	Paint	Pavement	Change
Waterborne paint only	0.40	0.81	-0.41
Waterborne paint with 1.5 IOR beads	0.45	0.81	-0.36
Waterborne paint with 1.9 IOR beads	0.58	0.84	-0.26
Waterborne paint with silica	0.66	0.78	-0.12
Waterborne paint with silica and 1.5 IOR beads	0.63	0.80	-0.17
Waterborne paint with silica and 1.9 IOR beads	0.67	0.81	-0.14

CONCLUSIONS

It can be concluded from this evaluation that the addition of glass beads in airport pavement markings does not decrease the friction coefficient of the pavement marking. In fact, there was an increase in the friction coefficient in every test stripe with beads when compared to those without any additives.

It was also concluded that by adding silica to the pavement markings the friction values of the markings are also increased; however, when glass beads were also added the benefit of the silica was reduced. This reduction in the benefit of the silica can be attributed to the fact that the texture of the stripe is being changed by the larger size glass beads.